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| UHLIR, NIKOLAS J | |

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Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. 09/785,416 | Applicant(s) TANAHASHI ET AL. | |
|---|---|---|---|
| | Examiner Nikolas J. Uhlir | Art Unit 1773 | |

-- Th MAILING DATE of this communication appears on th cover sh t with the correspond nce address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *10 September 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *2-9, 11-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-9 and 11-16* is/are rejected.

7)☒ Claim(s) *17* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. §§ 119 and 120**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 2-4, and 14 rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US2002/0064690) in view of Honda et al. (US5851643).

3. Claim 2 requires a perpendicular magnetic recording medium comprising a soft magnetic underlayer formed on a substrate, a non-magnetic amorphous metal layer containing Ni on the soft magnetic underlayer, and a perpendicular magnetic recording layer formed on the non-magnetic amorphous layer containing Ni, wherein the thickness of the non-magnetic layer is from 2nm-10nm.

4. For the purpose of clarity, it is noted that the examiner interprets the range, "from 2nm-10nm" as inclusive of 10nm.

5. Bearing the above interpretation in mind, Chen et al. (hereafter Chen) teaches a magnetic recording medium suitable for **either** longitudinal or perpendicular recording that comprises a substrate, an amorphous layer of NiNb on the substrate, and a magnetic layer on the NiNb layer (sections 25-28 and 43).

6. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize a perpendicular recording layer over the NiNB layer in Chen, as the layer structure is taught to be equivalent for forming either perpendicular or longitudinal recording media, which is ultimately determined by the c-axis orientation of the magnetic layer.

7. Further, Chen teaches that the amorphous NiNb layer is suitably 10-100nm thick (section 40). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the amorphous NiNb layer taught by Chen to a thickness of 10nm, as Chen explicitly teaches that this thickness is suitable. Thus, as 10nm is contained within the thickness range specified by claim 2, this requirement is met.

8. However, Chen fails to teach a soft magnetic underlayer between the amorphous NiNb layer and the magnetic layer, as required by claim 2.

9. However, with respect to this deficiency, Honda et al. (hereafter Honda) teaches a perpendicular magnetic recording medium that comprises a substrate, one or more underlayers, and a magnetic layer, and teaches that if a soft magnetic underlayer is formed between the substrate and the first underlayer, a magnetic recording medium having low noise and high read back output can be produced. Suitable soft magnetic materials include Sendust, Permalloy, and alloys of Fe, Co, Zr, Mo, Nb and W (column 23, lines 50-67).

10. Therefore it would have been obvious to one with ordinary skill in the art at the time the invention was made to utilize a soft magnetic underlayer as taught by Honda between the substrate and the NiNb layer taught by Chen.

11. One would have been motivated to make this modification due to the teaching in Honda that the read back output and noise of a perpendicular magnetic recording medium can be improved by utilizing a soft magnetic underlayer between the substrate and the 1st underlayer of a magnetic recording medium.

12. The limitations of claim 3 require that the amorphous layer containing Ni additionally contain Zr. It is noted that Chen teaches that the amorphous NiNb layer can additionally contain one or more elements selected from B, W, Ta, Zr, and P (section 40).

13. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to add Zr to the NiNb layer in Chen, as Zr is recognized to be equivalent to the other additive elements listed by Chen as suitable.

14. The applicant is respectfully reminded that substitution of equivalents requires no express motivation as long as the prior art recognizes the equivalency.

15. Claim 4 requires the amorphous Ni layer to contain both Zr and at least one element selected from Nb and Ta. This limitation is met as set forth above for claim 3.

16. The limitations of claim 14 require that the magnetic layer be formed directly on the "non-metal" layer. Regarding this limitation, claim 1 of Chen requires only a substrate, a NiNb layer, and a magnetic layer. Thus, in this 3-layer system, the magnetic layer would have to be formed on the NiNb layer, as the NiNb layer is formed between the substrate and the magnetic layer. Thus applicants claim 14 limitations are met by the combination of Chen with Honda.

17. Claims 5-9 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hokkyo et al. (US6387483) as evidenced by Mino et al. (US6023397).

18. Claim 5 requires a perpendicular magnetic recording medium having $\alpha$-Fe nano-crystals, which is formed on a substrate, a non-magnetic intermediate layer is formed on

the soft magnetic underlayer, wherein the soft magnetic underlayer is formed as an amorphous film by sputtering, and formed as a nano-crystalline film by annealing.

19. The limitation "wherein the soft magnetic underlayer is formed as an amorphous film by sputtering and formed as a nanocrystalline film by annealing" is a product-by-process limitation that does not appear to be further limiting in so far as the structure of the product is concerned. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). See MPEP § 2113. In the instant case, the claimed product only requires the soft magnetic layer to contain α-Fe nanocrystals, no specific structure of the soft magnetic film other than that the soft magnetic layer in the final product "comprise" a nanocrystalline film. It is important to note that the examiner does not interpret a film that comprises a soft magnetic film that is nanocrystalline to require the entire soft magnetic film to be nanocrystalline. As "comprising" is open language, a prior art soft magnetic layer need only contain some crystals to read on the instant claim language. Bearing this interpretation in mind, the examiner notes that it is known in the art that a soft magnetic film comprising α-Fe nanocrystals can be formed by a different process than that claimed by the applicant. This is evidenced by US6023397 to Mino et al., which establishes that α-Fe nanocrystals are formed in a soft magnetic film comprising FeTaN

or FeZrN, when the film is formed by sputtering and subsequently annealing the film at high temperature (i.e. 350$^0$C) (see column 5, lines 60-67; column 11 line 65-column 12, line 20).

20. Bearing the above in mind, Hokkyo et al. (hereafter Hokkyo) teaches a magnetic recording medium comprising a substrate, a Cr layer on the substrate, a soft magnetic layer on the Cr layer, and a perpendicular magnetic layer on the soft magnetic layer (column 9, lines 19-30). In addition, a nonmagnetic layer 9equivalent to applicants intermediate layer) such as a layer of Ti or non-magnetic CoCr is placed between the soft magnetic layer and the magnetic layer to improve the perpendicular orientation of the magnetic film (column 12, lines 32-24). While Hokkyo does not teach applicant's claimed process, Hokkyo does teach that suitable soft magnetic materials for forming the soft magnetic layers include FeTaN (column 3, lines 8-25), and teaches that the soft magnetic layers are suitably made via sputtering in an atmosphere of argon gas, followed by annealing the film (column 9, line 19-column 10, lines 2). The annealing takes place under the same conditions as those utilized in the formation of the perpendicular magnetic layer (column 10, lines 1-5). The perpendicular magnetic layer is formed while the substrate temperature is ~400$^0$ C. Thus, if the soft underlayer is annealed under the same conditions as utilized in the perpendicular film, the soft underlayer is formed on the substrate, and the substrate temperature is ~400$^0$ C, it is logical to infer that at least a portion of the film of Hokkyo will be annealed at 400$^0$ C. Further, as Hokkyo teaches that the annealing impacts the crystalline orientation of the soft magnetic underlayer, it is logical to infer from this fact that the soft magnetic

underlayer is crystalline (column 10, lines ). Finally, as the method of Hokkyo is formed form substantially the same as the method disclosed by Mino that results in the formation of α-Fe nanocrystals (sputtering followed by annealing at a temperature >350), and utilizes a similar alloy (FeTaN) (as discussed above at section 19), it is the examiners position that α-Fe nanocrystals will be formed in the film of Hokkyo. Thus, the limitations of claim 5 are met.

21. Regarding the property limitations of claims 6-8. It is the examiners position that these limitations are met as set forth above for claim 5. The soft underlayer of Hokkyo is formed by a method which is known in the art to produce α-Fe crystals from FeTaN alloys. As there is no showing to the contrary that the limitations of claims 6-8 are not necessarily met by the soft magnetic underlayer utilized by Hokkyo, these limitations are met.

22. Claim 9 requires the soft underlayer to contain Fe as a first element, at least one of C and N as a second element, and at least one kind of element selected from Ta, Hf, Nb, Ti, Zr as a third element. Hokkyo explicitly teaches the use of an FeTaN alloy as a suitable material for the soft magnetic underlayer. Thus, the limitations of claim 9 are met.

23. Claim 13 requires the nano-crystals to be ferromagnetic. The examiner takes the position that the sputtered and annealed FeTaN film utilized by Hokkyo meets this limitation for the same reasons set forth above for claim 5.

24. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen as modified by Honda as applied to claim 2 above, and further in view of Nakamura et al. (US5738927).

25. Chen as modified by Honda teaches all of the recording medium limitations of claim 11 as set forth above. However, Chen as modified by Honda does not teach the apparatus limitations of claim 11.

26. With respect to this deficiency, Nakamura et al. (hereafter Nakamura) teaches an apparatus for reading a perpendicular recording medium, wherein the apparatus comprises a holder for a perpendicular recording media, a magnetic head for recording and reproducing information from the medium, moving means for moving the media relative to the magnetic head, wherein the reproducing portion of the head is a magnetoresistive head (column 4, lines 23-46).

27. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the recording apparatus of Nakamura to read and record data on the perpendicular recording medium of Chen as modified by Honda.

28. One would have been motivated to do so due to the teaching in Nakamura that such an apparatus is suitable for recording and reproducing data with perpendicular recording media.

29. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hokkyo as evidenced by Mino as applied to claim 5 above, and further in view of Nakamura et al. (US5738927).

30. Hokkyo as stated above for claim 5 teaches all of the media limitations of claim 12 except for the applicants' requirement that the soft magnetic underlayer comprise α-Fe nanocrystals. While the examiner acknowledges that Hokkyo does not teach this limitation, Hokkyo does teach the use of a soft magnetic underlayer meeting the compositional requirements of claim 9 that is formed by a substantially identical process to that stated on page 8 of the specification, which results in the formation of α-Fe nano-crystals from an Fe-Ta alloy. Thus, the examiner takes the position that this limitation is met.

31. Further, It is noted that Hokkyo does not teach the apparatus limitations of claim 12.

32. However, Nakamura teaches an apparatus for reading a perpendicular recording medium, wherein the apparatus comprises a holder for a perpendicular recording media, a magnetic head for recording and reproducing information from the medium, moving means for moving the media relative to the magnetic head, wherein the reproducing portion of the head is a magnetoresistive head (column 4, lines 23-46).

33. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the recording apparatus of Nakamura to read and record data on the perpendicular recording medium of Hokkyo.

34. One would have been motivated to do so due to the teaching in Nakamura that such an apparatus is suitable for recording and reproducing data with perpendicular recording media.

35. Regarding the combination of Nakamura with Chen as modified by Honda and Nakamura with Hokkyo, the examiner acknowledges that the recording medium utilized by Nakamura is different from that utilized by Chen as modified by Honda or Hokkyo. However, the apparatus claimed by the applicant and disclosed by Nakamura is quite generic, and does not include specific limitations that would require a particular type of perpendicular media to be utilized in order for the apparatus' to function. Thus, although the media utilized in Nakamura is different then that of the other cited prior art and that of the instant invention, one of ordinary skill in the art would be motivated to utilize the apparatus recited by Nakamura with a reasonable expectation of success.

36. Claims 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hokkyo et al. (US6387483) in view of Chen et al. (US6475611), further in view of Chen et al. (US2002/0064690).

37. Claim 15 requires a perpendicular magnetic recording medium comprising a soft magnetic underlayer having α-Fe nanocrystals formed on a subtrate, a non-magnetic amorphous metal layer containing Ni on the soft magnetic underlayer, a perpendicular magnetic recording layer formed in the amorphous layer containing Ni, wherein the soft magnetic layer is formed as an amorphous film by sputtering and formed as a nanocrystalline film by annealing.

38. The limitations "formed as an amorphous film...film by annealing" are product by process as set forth at section 19 of this office action. Bearing this interpretation in mind, Hokkyo teaches a perpendicular recording film comprising a substrate, a soft magnetic underlayer on the substrate, a Ti intermediate layer on the soft magnetic layer, and a

perpendicular recording layer on the intermediate layer (column 9, lines 15-65, column 12, lines 18-21). FeTaN is suitably utilized to for the soft magnetic layer (column 3, lines 8-25), and the soft underlayer is deposited by sputtering and is annealed after it is deposited (column 9, line 15-column 10, line 2). The annealing takes place under the same conditions as those in which the perpendicular magnetic layer is deposited (column 10, lines 1-3). Thus, as the perpendicular recording layer is deposited while maintaining the substrate temperature at ~400$^0$C (column 9, lines 19-30), it is logical to infer that at least some portion of the soft underlayer will be annealed at 400$^0$ C. As it is known in the art of magnetic recording media that FeTaN films that are formed by sputtering and subsequently annealed at temperatures >350$^0$ C form α-Fe nanocrystals (as shown above at section 19 of this action), the examiner takes the position that the FeTaN film of Hokkyo will possess α-Fe nanocrystals. Further, Hokkyo teaches that the annealing step improves the crystalline orientation of the soft magnetic layer, thus, the requirement that the soft magnetic layer be crystalline is met.

39. However, Hokkyo dos not teach the use of an amorphous layer containing Ni between the perpendicular recording layer and the soft magnetic underlayer as required by claim 15.

40. Regarding this deficiency, Chen '611 teaches that by placing a NiNb layer between a soft magnetic layer and a perpendicular recording layer of a recording medium, the coercivity of a recording medium is increased (column 2, lines 49-61). Further, this coercivity enhancing layer is suitably formed overtop an adhesion layer of Ti or Ti alloy, which is formed over the soft magnetic underlayer (column 4, lines 8-17).

41. Therefore it would have been obvious to one of ordinary skill in the art to utilize a NiNb layer as taught by Chen '611 between the Ti layer and the perpendicular recording layer utilized by Hokkyo.

42. One would have been motivated to make this modification due to the teaching in Chen '611 that by utilizing a NiNb layer between a Soft magnetic layer and a perpendicular recording layer, the coercivity of the medium is enhanced. One would have specifically selected NiNb from the materials listed by Chen '611 in lieu of the fact that these materials are all recognized as equivalent for use as coercivity enhancing layers. While the examiner acknowledges that later in the specification Chen '611 teaches that NiNb has a negative impact on coercivity, this only appears to apply to situations where a perpendicular recording medium having an artificial lattice structure is utilized.

43. However, Hokkyo as modified by Chen '611 fails to teach that the use of an amorphous Ni containing layer between the soft magnetic layer and magnetic layer, as required by claim 15.

44. However, Chen '690 teaches that by utilizing an amorphous NiNb underlayer in a recording medium that utilizes a glass substrate, Li and other ions can be prevented from leaching into and corroding the recording layer (sections 25, 28).

45. Therefore it would have been obvious to one of ordinary skill in the art to utilize utilize an amorphous NiNb layer as taught by Chen '690 as the NiNb layer taught by Hokkyo as modified by Chen '611.

46. One would have been motivated to make this modification in lieu of the teaching in Chen '690 that by utilizing an amorphous NiNb layer between a perpendicular recording layer and a glass substrate, Li and other ions from the subtrate are blocked from leaching into and corroding the recording layer. One would have been especially motivated by this fact as the recording medium taught by Hokkyo utilizes a glass substrate.

47. Claim 16 requires the amorphous Ni containing layer to be from 2-10nm thick. Chen '690 teaches that the amorphous NiNb layer is suitably 10-100nm thick (section 40).

48. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the amorphous NiNb layer utilized in Hokkyo as modified by Chen '611 and Chen '690 to be 10n m thick, as 10nm is specifically cited to be a suitable thickness for the NiNb layer.

***Allowable Subject Matter***

49. Claim 17 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

50. The following is a statement of reasons for the indication of allowable subject matter: The closest prior art to that of the instant invention in US6387483 to Hokkyo et al. Hokkyo fails to teach a soft underlayer containing Fe, Ta, and C and α-Fe nanocrystals. While the use of soft magnetic films containing Fe, Ta, and C is known in the art of magnetic recording media, there is no teaching in the art of the formation of α-

Fe nanocrystals in a film containing Fe, Ta, and C. Further, Hokkyo fails to teach an amorphous metal layer between the Fe, Ta, and C containing soft magnetic layer, wherein the amorphous metal layer contains Ni, Zr, and Ta. While the use of this type of amorphous metal layer is known in the art, as shown by US2002/0064690 to Chen et al., there is no teaching or motivation to utilize this layer in combination with an Fe, Ta, and C containing soft magnetic layer that contains α-Fe nanocrystals.

***Response to Arguments***

51. Applicant's arguments filed 9/10/03 have been fully considered but they are not persuasive. In the instant case, the applicants arguments are essentially that the thickness of the prior art amorphous Ni containing films is greater than that utilized in the instant invention, and that an α-Fe nanocrystal containing soft magnetic underlayer that is made by first sputter depositing an amorphous film and annealing the amorphous film to form a nanocrystalline film exhibits unexpectedly improved properties over that fo a soft magnetic layer formed by another method.

52. Regarding the applicants thickness argument. This argument is unpersuasive in lieu of the fact that the prior art teaches an amorphous NiNb, wherein the thickness range for the NiNb layer has an endpoint which meets the applicants claimed range. Namely, the instant claims require a amorphous Ni containing film that is from 2 to 10nm thick. This range is inclusive of 10nm. The prior art teaches an amorphous NiNb layer that is 10-100nm thick. Thus, as 10nm is within the claimed range, this argument is moot.

53. Regarding the applicant's argument with regards to unexpected results. The examiner acknowledges that the applicant has tried to establish that a soft magnetic underlayer formed by the claimed process exhibits "unexpectedly" improved saturation magnetization over that of a soft underlayer that is deposited in an already crystalline form. This argument is unpersuasive for two primary reasons. First and foremost, the prior art recognizes that a FeTaN film formed by the method disclosed in Hokkyo results in the formation of $\alpha$-Fe nanocrystals. The claimed product only requires the soft magnetic layer to contain $\alpha$-Fe nanocrystals. The claimed product does not require any particular crystal structure for the remainder of the film (i.e. 3d precipitation of crystals as opposed to columnar formation, increased saturation magnetization etc...). Thus, the instant claims are not commensurate in scope with the purported "unexpected" result. Second, even if the instant claims were commensurate in scope with the asserted showing, the applicant has not compared the instantly claimed soft magnetic underlayer to that of the closest prior art, namely Hokkyo. Thus, there is no showing that establishes that the cited prior art does not possess the properties required by the instant product, and that the process for forming the claimed product indeed produces an "unexpected" result over the prior art.

***Conclusion***

54. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nikolas J. Uhlir whose telephone number is 703-305-0179. The examiner can normally be reached on Mon-Fri 7:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Thibodeau can be reached on 703-308-2367. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9310.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-0389.

D. S. NAKARANI
PRIMARY EXAMINER Acting SPE

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